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Intellectual Property
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EXAMINER	
STALDER, MELISSA A	
ART UNIT	PAPER NUMBER
4162	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/535,501	SUN ET AL.	
	Examiner	Art Unit	
	MELISSA STALDER	4162	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *27-61* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *27-61* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05/18/05* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *05/18/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities: paragraph 6 of the amendment to the specification contains a number with the label "abs." Additionally, paragraph 8 also contains a pressure labeled the same.

Appropriate correction is required.

Drawings

2. The drawings are objected to because preheating furnace 305 discussed in the specification is not labeled in Figure 4. Figure 3 contains a preheating furnace already labeled 203. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the

examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

1. Claim 57 objected to because of the following informalities: spelling error. In Claim 57, line 6 the word "econd" is misspelled.

2. Claim 49 objected to because of the following informalities: applicant has claimed the temperature range 1100° C to 300° C in lines 6-7, which may not be the range that applicant intended to claim.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 27 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5. The claim recites the limitation "various streams" in (c). There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 27-40, 42-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj (US 6,048,472). Nataraj '472 teaches a two-step method of producing synthesis gas where a hydrocarbon mixture is first pre-reformed and then reformed in a catalytic ceramic membrane after the first product is combined with an oxygen-containing gas. The synthesis gas produced comprises at least hydrogen, carbon containing compounds, water, and an oxygen-depleted mixture. The present claims disclose the heating of an oxidizing mixture to a temperature between 871° to 1300° C prior to reforming. Nataraj does not teach this temperature range. However, Nataraj discloses heating oxygen-containing gases by direct combustion with a fuel gas (col. 7, lines 45-48). The $\Delta_c H°/kJ\ mol^{-1}$ of methane is 891° C of methane. This temperature falls in the range of the claims. It would have been obvious to one of ordinary skill in the art at the time of the invention that combustion of a hydrocarbon gas in the presence of oxygen would heat the oxidizing gas to a temperature within the claimed range because a greater number of hydrocarbon bonds in a fuel gas will increase the temperature at which combustion occurs.

8. Regarding Claim 28, the Nataraj teaches specific temperature 1000° C, overlaps with the range of hydrocarbon combustion.

9. Regarding Claim 29, Nataraj teaches in column 12, line 54 that the heated oxidant is at a temperature preferably within 200° F (111°C) of the partially reformed gas.

10. Regarding Claim 30, Nataraj teaches (col. 11, line 3) that desulphurization of a hydrocarbon mixture prior to reformation is well known in the steam reformation art.

11. Regarding Claims 31 and 33, Nataraj teaches desulfurization of a reactant gas at 260° C to 427° C (col. 10, line 65) which overlaps with the instant range. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

12. Regarding Claim 32, Nataraj teaches (col.10, line 65) the hydrogenation of a reactant gas prior to the desulfurization step. Column 11, lines 2-5 states that a hydrogenation step is well known in the steam reforming art.

13. Regarding Claims 34 and 36, Nataraj teaches (col. 11, line 32) that pre-reformation can occur in a catalytic reactor at a temperature between 372° C to 550° C. This range completely encompasses the applicant's claim.

14. Regarding Claim 35, Nataraj teaches (col. 7, line 3) the use of an adiabatic reactor in a pre-reformation step.

15. Regarding Claims 37-38, Nataraj teaches in column 15, lines 37-67 that the oxygen-depleted nonpermeate is at a temperature at or slightly below that of the raw synthesis gas product. The temperature of the oxygen-depleted gas can be within 5° to 100° C of the synthesis gas. Nataraj also teaches (col. 14, line 50) that the reactant gas - the oxygen-containing gas—is preferably heated to the preferred temperature range of 816°, which is the same temperature as the raw synthesis gas when it is withdrawn from the outlet of the membrane reactor (col. 15, line 49). The claim states that the

temperature difference is at least 75° C, which is encompassed in the disclosed range in Nataraj.

16. Regarding Claims 39 and 40, Nataraj teaches (col. 12, line 8) that the temperature range of the intermediate gas is 594° C to 760° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range.

17. Regarding Claim 42, Nataraj teaches (col. 16, line 59) that raw synthesis gas can be cooled and carbon dioxide can be removed from the synthesis gas.

18. Regarding Claims 43 and 44, Nataraj teaches a purification or treatment of the synthesis gas (col. 17, lines 12-18).

19. Regarding Claim 45, Nataraj teaches (col. 18, lines 55-60) the use of treated oxygen containing gas and the use of this gas in direct combustion (col. 19, line 36). Nataraj discloses the use of air as an oxygenated gas. Air is typically 15-21% by volume O_2. It would be obvious to one of ordinary skill in the art to increase the percentage molarity of oxygen in the oxygenated gas mixture the reaction for the combustion of methane requires 2 moles of oxygen for every 1 mol of methane. Therefore, a greater volume of oxygen will make the reformation step more effective.

20. Regarding Claim 46-47, Nataraj teaches (col. 6, lines 47-57) the preheating of oxygen by heat exchange with the oxygen-depleted nonpermeate gas and a reformer.

Nataraj also teaches direct combustion of a heating gas with an oxygenated gas in a combustion chamber.

21. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj in view of Prasad (US 6,695,984). Nataraj states in column 15, line 57 that the temperature of the oxygen-depleted non-permeate is either at or slightly below that of raw synthesis gas. However, Nataraj does not teach the claimed temperature range of 800° C to 1100° C. Prasad refers in line 8 of claim 12 to a synthesis gas stream at a temperature between 950° and 1100° C. *In re Malagari*, 182 USPQ 549 (1974), found that a claimed invention is prima facie obvious over prior art if the applicant's claimed range touches a preferred range and the applicant has not rebutted the prima facie finding with a showing of unexpected properties in the range or a teaching away of the claimed range. It would have been obvious to one of ordinary skill in the art of synthesis gas production to combine these references as Nataraj teaches that the preferred temperature range is greater than 816° C (col. 18, lines 7 and 16). Further, Prasad teaches (col. 6, line 51) that temperatures of 1000° C to 1100° C in a reactor facilitate a nearly complete conversion of methane.

22. Claims 48-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nataraj (US 6,048,472) in view of Holm-Larsen (US 5,937,631). Nataraj teaches (col. 14, lines 55-59) the use of an oxygenated gas that is partly a combustion gas. The gas is preferably at 10 psi gauge but can be anywhere between 1 to 900 psig (1×10^5 to 62.05×10^5 Pa). Nataraj also teaches the temperature range of 594° C to 760° C. The applicant claims 2×10^5 Pa abs, which is between 14-15 psig. However, Nataraj does

not teach the use of a gas turbine in the production of oxygenated gas from a combustion gas. Holm-Larsen teaches (col. 2, lines 30-35) the use of a gas turbine that produces an oxygen containing gas that is passed to a combustion chamber. Holm-Larsen teaches in column 3, lines 37-40 that the use of a gas turbine in synthesis gas production creates considerable energy saving. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a gas turbine synthesis gas in the process of Nataraj as it is taught by Holm-Larsen that the use of a gas turbine creates considerable energy savings. Therefore, Holm-Larsen teaches the addition of a gas turbine between the combustion chamber and the reactor.

23. Regarding Claim 49, Holm-Larsen teaches the combination of the generation of synthesis gas and the production of electrical power through the application of a gas turbine. In column 2, line 65, Holm-Larsen teaches the application of a "sufficiently high temperature" that is typically 1300° C. Table 1in Holm-Larsen also teaches the use of combustion gas at 1000° C, which falls within the claimed range of 300° C to 1100° C. Additionally, Holm-Larsen teaches the use of a combustion gas at a pressure of 20 kg/cm^2 gauge (20.6×10^5 Pa). The ranges taught by Holm-Larsen overlap with the instant claims and furthermore, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize and adjust the temperature and pressure to increase or decrease the reaction rate.

24. Regarding Claim 50, Holm-Larsen teaches in claim 1, line 15 the use of oxygen containing gas in the production of electrical power.

25. Regarding Claim 51, Holm-Larsen teaches the use of exhaust gas from a turbine for heating a reformer (col. 2, line 37). Nataraj teaches the use of an oxygen-depleted mixture in a preheating furnace. Holm-Larsen teaches in column 3, lines 37-40 that the use of a gas turbine in synthesis gas production creates considerable energy savings. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to combine all the steps of a traditional synthesis gas production as in Nataraj with the use of a turbine in a post-combustion step for energy savings.

26. Regarding Claim 52, Nataraj teaches (col. 14, lines 52-59) the use of total gas pressure on the reactant side in the range of 1 to 900 psig and total gas pressure on the oxidant side in the range of 1 to 900 psig.

27. Regarding Claim 53, Holm-Larsen teaches in column 2, lines 29-48 the use of an oxygen-containing exhaust gas that came from combustion air that is then sent to a combustion chamber where it is use for burning additional fuel.

28. Regarding claim 54, Holm-Larsen teaches in column 2, lines 38-41 the use of a combustion air that is sent to a gas turbine compressor before it is sent to the combustion chamber.

29. Regarding claim 55, Nataraj teaches the use of an oxidizing mixture in the range of 1 to 900 psi gauge (1.00×10^5 to 62.05×10^5 Pa). Table 1in Holm-Larsen teaches the use of combustion gas at 1000° C, which falls within the claimed range of 871° C to 1100° C. It would have been obvious for one of ordinary skill in the art to combine the temperature range in Holm-Larsen and the pressure disclosed in Nataraj because Holm-Larsen discloses in column 2, lines 65-67 that the use of a sufficiently high

temperature and high flow rate are necessary to supply heat for the endothermic reforming process.

30. Regarding claim 56, Nataraj teaches (col. 14, lines 52-59) the use of total gas pressure on the reactant side in the range of 1 to 900 psig and total gas pressure on the oxidant side in the range of 1 to 900 psig.

31. Regarding claim 57, Holm-Larsen teaches (col. 3, lines 10) the use of a gas turbine air compressor and compression of air in one or more stages. In column 3, lines 31-33, Holm Larsen discloses that the compression combustion air from the air compressor may be bypassed directly to the secondary combustion chamber.

32. Regarding claim 58, Holm-Larsen teaches (col. 3, lines 10) the use of a gas turbine air compressor and compression of air in one or more stages. Nataraj teaches the use of an oxidizing mixture in the range of 1 to 900 psi gauge (1.00×10^4 to 62.05×10^5). Table 1in Holm-Larsen teaches the use of combustion gas at 1000° C, which falls within the claimed range of 871° C to 1100° C. It would have been obvious for one of ordinary skill in the art to combine the temperature range in Holm-Larsen and the pressure disclosed in Nataraj because Holm-Larsen discloses in column 2, lines 65-67 that the use of a sufficiently high temperature and high flow rate are necessary to supply heat for the endothermic reforming process.

33. Regarding claim 59, Holm-Larsen teaches (col. 3, lines 10) the use of a gas turbine air compressor and compression of air in one or more stages. Holm-Larsen also teaches in claim 1, line 15 the use of oxygen containing gas in the production of electrical power.

34. Regarding claim 60, Holm-Larsen teaches (col. 3, lines 10) the use of a gas turbine air compressor and compression of air in one or more stages. Holm-Larsen teaches the use of exhaust gas from a turbine for heating a reformer (col. 2, line 37). Nataraj teaches the use of an oxygen-depleted mixture to in a preheating furnace. Holm-Larsen teaches in column 3, lines 37-40 that the use of synthesis gas production with a gas turbine creates considerable energy saving. Therefore, it would have been obvious to combine all the steps of a traditional synthesis gas production as in Nataraj with the use of a turbine in a post-combustion step to save energy.

35. Regarding claim 61, Nataraj teaches (col. 7, lines 57-62) the use of the oxygen-depleted nonpermeate gas as part of the oxygen-containing reformer oxidant gas. Nataraj also teaches the use of an oxidizing mixture in the range of 1 to 900 psi gauge (1×10^5 to 62.05×10^5 Pa). Holm-Larsen teaches the use of an oxygen stream at 15° C (59° F), which is substantially ambient temperature. Air is typically 15-21% by volume O_2. It would have been obvious to one of ordinary skill in the art to increase the percentage molarity of oxygen in the oxygenated gas mixture the reaction for the combustion of methane requires 2 moles of oxygen for every 1 mol of methane. Therefore, more a greater volume of oxygen will make the reformation step more efficient.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MELISSA STALDER whose telephone number is

(571)270-5832. The examiner can normally be reached on Monday-Friday, 8:00-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571-272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MS

/Jennifer McNeil/
Supervisory Patent Examiner, Art Unit 4162